DATA SPACES SUPPORT CENTRE

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Business perspective of inspiring Data Space examples

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DATA SPACES
SUPPORT CENTRE

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1. Introduction

The concept of data spaces and the related technology has matured significantly in the last years and they are being implemented at a large scale in Europe.[1] Although there are several hundred initiatives that aim to become self-sustaining data spaces, relatively few have discovered or implemented a business model that allows them to really become self-sustaining.[2] This paper will dive into the mechanisms that make a data space business model work while providing examples of such mechanisms that have already been implemented. The goal of the paper is to provide insights into what elements data spaces can consider to ensure their financial sustainability.

This paper is for people who want to start a data space, are working on a data space initiative, or want to revisit the business model of an existing data space. Additionally, this paper is meant for people who want to know more about the ways in which data spaces can become financially sustainable, and – when desired – profitable.

1.1. The challenge of starting an economically viable data space

Establishing an economically viable and active data space can be a real challenge. Reflections from the DSSC community (certain Common European Data Spaces and beyond including participants of data spaces) underline the emerging challenges.[3] Various related questions pop up such as: Where to start when setting up a data space? How do I make my business model economically viable? How to deal with different types of stakeholders within and around my data space?

Many initiatives are looking for concrete guidance on how to develop a successful data space with a suitable and viable business model. Challenges abound, which this paper addresses, with a main focus on the business challenge (the balance between revenues and costs). There is no overview of successful data spaces yet, and no analysis that shows their best practices. While success can be context-dependent, there are discernible commonalities that can help to inform business model discussions. These commonalities are discussed in this paper.

Although data sharing has generated revenue for companies for decades, data spaces unite organisations in a distinct configuration. Multiple parties adopt various new roles in parallel, such as data provider, data user, and service provider. We refer to this uniting of organisations by data space as **collaborative**. For a data space to be useful, both data provision and data use need to have a

[1] Common European data space: https://digital-strategy.ec.europa.eu/en/policies/data-spaces
[2] Data spaces radar: https://www.dataspaces-radar.org/radar/
[3] For more details on the community realities & challenges for data spaces, see the 3rd DSSC SSF Collaborative paper Rogotis S., etal. Participant Adoption and Sustainability in data spaces November 2025 .

critical mass. We refer to this as **multi-sidedness** as it represents the supply and demand side of a data space.

One of the key values that data spaces look to guarantee is 'data sovereignty'. From a business perspective, this means that organisations looking to share data retain their full rights over the data shared. This differentiates data spaces from platforms in which participants sometimes surrender some rights to the platform in order to access the benefits offered by the platform. This requires organisations involved to establish sovereignty and to organise and govern their data space in such a way that it realises this.

To arrive at a successful data space, many things need to be collectively developed and agreed upon such as: interoperability standards, technical infrastructure and implementation, and organisational governance, and legal compliance. This implies that stakeholders must invest time and effort to find consensus on prerequisites and align before arriving at a successful data space. As such, any predefined ways of working can help to shorten this initial negotiation process, which makes establishing good practice more important. This paper aims to answer this need for support in the collaborative design of a data space.

The development of a data space does not happen out of nothing, and requires many things, including financial resources. Financial resources can come from public funding and/or private financing. Naturally, funders and financers get a say in the design and organisation of the data space they fund, and funders bring their own perspective and logic to these processes. In this paper, we argue that the development of data spaces requires a mix of both public and private logic, to balance the creation of 'public' value (e.g., maintaining participants' sovereignty), while also ensuring economic viability (typically well-established by private or business logic). Acknowledging and balancing these perspectives can challenge established mindsets. Here, we refer to the parable of Baron von Münchhausen, who managed to get himself and his horse out of the mud by applying a novel perspective to the situation, and by pulling himself up by his hair (illustrated in Figure 1).

Figure 1: Baron von Münchhausen.

1.2. Reading guide

The rest of the paper is composed as follows. In Chapter 2, we start by explaining the business perspective and business challenge of a data space. This chapter starts with the data space offering and the role of the governance authority in providing this offering, followed by the various perspectives on the business challenge of the data space: public vs private and linear vs multi-sided. Chapter 3, describes the pathways to deal with the business challenge. This chapter is framed around

five dimensions of the business challenge that are discussed by drawing on five illustrative examples of data spaces and data space related initiatives. These examples focus on different sectors. In Chapter 4, the conclusions and recommendations are provided.

2. The business perspective and business challenge

In this Chapter we discuss our view on the business perspective in section 2.1 and the business challenge of a data space in section 2.2.

2.1 Business perspective

Important to the business perspective of a data space are the data space offering so the data products and services offered by the data space and its participants and the data space governance authority that fulfills an important role in providing the offering.

2.1.1 Data Space Offering

Figure 2 gives an overview of offerings that various parties in the data space ecosystem could provide to one another. Central to those services is the data space offering, which includes data products and services shared among participants, with a clear distinction between individual actors' offerings and the enabling services that facilitate their sharing.

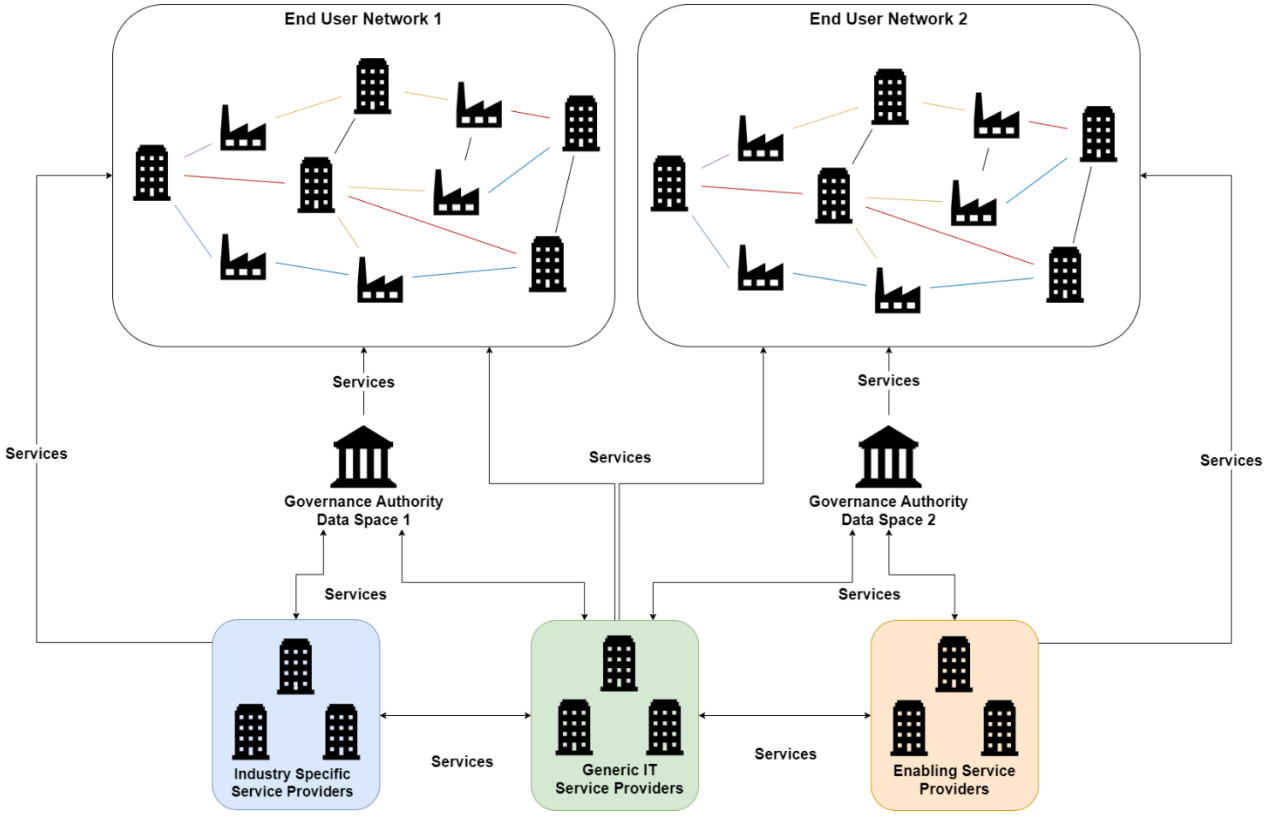

Figure 2 High level overview of offerings in the ecosystem of the data space

Legend Figure 2
End-user network: these are companies and organisations that are connected with one another in doing business, you could perceive this as an industry or a value network producing a certain good or service. These companies will use the data space to enhance their business, therewith calling them end-user network. These parties could both be participants to the data space and members of the data space.
Governance Authority: the body of a particular data space, consisting of participants that is committed to the governance framework for the data space, and responsible for developing, maintaining, operating and enforcing the governance framework. The governance authority should also monitor the services, that are being offered within the data space.
Services: Functionalities for implementing data space capabilities, offered to participants of data spaces. Technical (software) components are usually needed to implement these services. However, services could also be maintaining a rulebook or a controlling entry into the data space.
Industry Specific service providers: providing services which are specific to the industry. For example an algorithm to plan maintenance and down-time for a manufacturing plant.
Generic IT service providers: are service providers that do not identify with a specific industry, therewith they provide services which could be used in many different data spaces, such as hosting, but could also provide participant agents.
Enabling service providers: these service providers offer services to support the functioning and development of data spaces. These services can include data sharing tools, cloud capacities, and other infrastructure that facilitate secure, reliable, and interoperable data exchange among diverse actors.
different coloured lines between end users: these represent different kinds of transactions that end-users make. This could be data, data products, services, goods, and money.

BOX 1 - Explanation of Figure 2:

The purpose of figure 2 is to show that there are services being delivered at multiple levels within the data space ecosystem. Often discussions about what the data space offers specifically focus on what offerings and data products are delivered between the different participants in the end user networks, or what is delivered to this end user network. This figure shows that within the data space ecosystem, services are also delivered between service providers and/or the governance authority (for more details on the governance authority see section 2.1.2).

What these services are, is heavily dependent on the sector of the Involved data space, the focus of the data space, the organisational structure of the data space and the service design. Therefore, what these services are, is not specified in detail for each of the different parties.
For a data space to work, enough value needs to be created within the end user network to support the other parties like governance authorities and enabling service providers, such as the data space operator or intermediaries. For example, within the Smart Connected Supplier data space (SCSN) order data is shared within a high-tech, high-mix, low-volume (complex and tailor-made machines) supply network. This creates enough value, i.e., reduces administrative costs sufficiently, for the participants of SCSN to pay service providers for this service. If the value created through the data space was insufficient for the parties within the end user network of SCSN, these parties would be unwilling to participate in the data space and pay a fee to the service providers. In other words, the data space would not be economically viable.

It is important to define these services for each of the participants within the data space ecosystem. For example, DjustConnect (an agricultural data space in Flanders), or more specifically its data space operator EV-ILVO, provides an interface for application developers to develop and publish

applications on their ConnectShop.[4] This service is not meant for every participant within the data space ecosystem, but specifically for developers of applications. The services that these applications offer, have their own audience. For example, downloading one of the applications related to the *Milk Payment Statement*, is only relevant for farmers producing milk, and for the partners purchasing their milk from them.

Consider both examples, SCSN and DjustConnect, there might be, e.g., hosting services delivered from generic IT service providers to industry-specific service providers. Services are also being delivered and exchanged between industry specific service providers. Rather than via a straightforward one-way supplier-customer relationship, the data space becomes a (dynamic) business ecosystem. Within this data space ecosystem, organisations can both provide services to and demand services from one another. This ecosystem is only able to be maintained when each of these parties, such as the general and industry specific service providers, provide enough value to the parties in the end-user network.

In summary, there are three kinds of service providers who are relevant for a given data space:

- Service providers *outside* the data space (generic IT service providers such as cloud hosting services or sector-specific service providers who cater to individual end users regardless of those end users' participation or not in a data space);
- Service providers *enabling* the data space (this could be the data space governance authority itself, or one or more service providers, operators, or intermediaries, who are specifically appointed by the governance framework);
- Service providers *within* the data space (participants whose offering to other participants is a service).

For each of the organisations in Figure 2, an individual Data Space Offering needs to be made. An offering concerns not only the service, but also a pricing model, licences, terms and conditions, Service Level Agreements, etc. How all of these services are delivered needs to be detailed out as well, in combination with an organisation that can sell and maintain these services.

For example, the FEDeRATED project[5] supports multi-modal transport of goods and cargo involving trucking companies, barging terminals, train operators, open sea transport companies, shipping agents, and others. A use case that could be delivered through the data space is enabling transport of containers efficiently to save time, money, and emissions. A client registers a container containing their goods with a shipping agent. The shipping agent would pay for finding the most optimal transportation path for goods as quickly as possible, thereby decreasing the costs of planning and placing the container. This could help the shipping agent to increase profit (lower costs) or decrease the price to become more competitive. As the container is registered in the data space, the

[4] **ConnectShop | DjustConnect**
[5] FEDeRATED: https://www.federatedplatforms.eu/

transporter could decrease the time at customs as the customs agency was already notified on beforehand that the container was on its way and could start the clearing in process already. Then the container is placed on a truck and delivered to its destination.

The algorithms determining the most optimal transportation route are a service offered by service providers *within* the data space. These service providers in turn need a place to host these algorithms (provided by a hosting service provider *outside* the data space). They also need to connect to the data space themselves as well, to be able to provide their algorithms in something such as an app store, and find the technical standards to ensure compatibility (services *enabling* the data space). Through the journey of the container one can see how the entire network is interacting to allow for the data space offering to create value for the end-user network.

2.1.2 The role of the Governance Authority

Ensuring that every party gets the business value or other value out of joining a data space is a job for the data space governance authority (from here on called the governance authority). To set up a data space, it is crucial to define the business case for each type of participant. That includes the business model for the governance authority itself.

Basic tasks of the governance authority are developing, maintaining, operating and enforcing the governance framework.[6] This work requires resources and therefore needs to be financed by the data space. This can be done in multiple ways: the users of the data space could contribute (in kind) to the governance authority, the governance authority requests a fee from the users and participants of the data space, or the governance authority starts offering services itself to the data space.

There are different services a governance authority could provide to support its activities. For example, combining the role of the governance authority with a role as operator, supplying (parts of) the services *enabling* in data space (like participants agents, a central catalogue, an app store, participation management, compliance monitoring, etc.). Another option could be to provide services as a service offering *within* data space just like any other participant, although in this case there is a risk of a conflict of interest that needs to be properly managed.

Also important here is to start experimenting quickly with different business models for and services offered by the governance authority. This will help to understand the added value the participants and users feel the governance authority has and will increase the speed with which a suitable business model is found for the governance authority.

[6] DSSC Blueprint: **https://dssc.eu/space/BVE2/1071251781/1+Key+Concept+Definitions**

2.2 Perspectives on the business challenge

How a data space addresses its business challenges is influenced by different perspectives, two of which we have identified as key. The first perspective is determined by whether a primarily public or private approach is adopted, and the second perspective is determined by whether a linear or non-linear approach is adopted. In this chapter we highlight the differences and argue that data sharing initiatives should balance both public and private as well as linear and non-linear views.

Data space initiatives may have different **views on the business challenge** at hand. With business challenge, we mean that a data space generally needs to balance revenues and costs. However, as data spaces can be both publicly and privately oriented, their value creation options can also be diverse. For example, the value created could be expressed in different ways, such as by economic value (e.g., decreasing costs enabled by more efficient data sharing) or societal value (such as wellbeing, or supporting insights on the reduction of the CO2 emissions). But, since each additional user and use makes the data space more valuable, value created could also be expressed by the number of users, number of data sources, number of affiliated organisations, number of data transactions (i.e., each time a data source is used) as proxies for (economic or societal) value created. Note that value creation is different from value capturing. Value capturing refers to how organisations and individuals benefit from participating in data sharing. This can refer to receiving monetary compensation, but also to (easier) meeting regulatory obligations, or strategic benefits. In the next section we focus on the public and the private perspective on this.

2.2.1 Public vs private approach

Public funding and public orientation play a role in how data spaces perceive their business challenge. We are convinced that data spaces need to start experimenting—as soon as possible—with different revenue streams and selling points for individual participants (rather than only broad value propositions for an entire data space), to ensure the usability and financial sustainability of the data space, whether it is publicly funded or privately financed, or a combination of both financial streams. This section explores the differences between adopting a public versus a private approach to the business challenges of data spaces.

Public approach

Publicly oriented data space initiatives rely on funding and data from public actors or look to solve a societal challenge that the market will not pick up. Often, publicly oriented data spaces focus on an open catalogue, the adoption of open standards, and the focus on data quality. This concerns the 'supply' side of the data space (dimension "data and infrastructure"). A potential drawback of this approach is that efforts on 'market demand' (dimension "Use cases and applications") are often left out of scope, which could lead to underutilisation of the offerings made available and thus might limit the realised value of the data space.

Additionally, when public research grants are involved, engaging in economic activities can break state aid rules. So, while grants often require 'financial sustainability' plans, these are often theoretical exercises created by actors who will not be the ones to commercialise the results themselves and potentially lack the required expertise to develop and execute the plans efficiently. Therefore, the development of commercial applications is often left at a minimum in these cases.

Publicly oriented data space initiatives also often focus on addressing a societal challenge (e.g., zero waste, better data sovereignty; dimension "Vision and governance") without a focus on the (private) business perspective (dimension "Business and Viability"). This societal challenge could be the groundwork for digitisation or conservation efforts, such as in Europeana[7] example. In this example, the lack of a clear value capture opportunity may limit private participation, as the goal of any private enterprise is to grow and thrive financially.

For publicly oriented data spaces, the starting point is often one where the business model of the participating organisations aims to provide free or subsidised services enabled by funding received from public bodies. The primary risk with this model is that it could take away the incentive to become more market, customer, and demand oriented, whereas the purpose of the public funding for data space initiatives should be to mobilise private financing as a response to demonstrated value creation and value capture potential.

In publicly oriented initiatives, another challenge is the lack of risk appetite. For some topics, such as quantum technology for data spaces, pay-offs from investments may be fairly far down the road and may be fraught with risks. Public parties are especially willing to provide the necessary capital for the greater common good to which the technology or data space initiative under development might contribute.

In summary, some of the drawbacks of publicly oriented approaches to data space development are:

a) potential underutilisation of data space offerings due to a lack of "demand" side focus,

b) limitations of resource allocation to the development of commercial use cases and applications due to conditions associated with public funding,

c) lack of clear value capture opportunities for private actors due to a primary focus on remedying societal problems,

d) potential unattractiveness to private financiers due to lack of demonstrated market demand and associated value capture potential stemming from overreliance on public funding, and

e) lack of ambition of the initiatives due to risk-averseness.

To address some of these drawbacks, several mitigating actions can be taken. An open use case development approach could for instance be an option to provide solutions for societal challenges

[7] This initiative is focused on organising access to a distributed collection of digitised cultural heritage items.

while achieving financial sustainability. This approach can, for example, be facilitated by hackathons that do not interfere with the market by "picking winners". There are also several options for innovation procurement and forward commitment to engage market orientation while also serving public interest. Public funding could also be tied more explicitly to the demonstrated impact of the initiatives funded.

On the other hand, public funding also has benefits that can be stimulated. In addition to being targeted at creating societal good, which benefits all people and businesses in general, in specific cases (e.g., in cases of observed market failure) public parties are able to invest for longer periods of time in, e.g., the maintenance of public infrastructure or the development of key enabling open technologies and standards. This type of long-term investments are typically not made by private financers.

Private approach

Privately oriented and financed initiatives work with different principles than publicly oriented and funded initiatives. Contrary to most publicly oriented initiatives, a strong focus on obtaining financial returns is present in privately oriented initiatives. This means that business development, i.e., efforts to attract paying customers or use cases to illustrate the value of the initiative (dimensions "Use cases and applications", "Users and authorisation", and "Business and Viability"), is a priority. This could mean, for instance, investments into the search for a 'killer-app', or the use case that inspires new paying customers to join the initiative.

Privately oriented initiatives have less need to be inclusive in terms of their customers and business model (dimension "Vision and governance"), which means that their focus is typically at first on the building a 'minimum viable' set-up. A minimum viable setup usually means a combination of paying customers and an offering that is curated specifically to meeting this customer group's requirements (dimension "data and infrastructure"). This focus is in contrast with including and covering a broader set of requirements for use cases whose parties cannot afford, or are not willing to pay, for the offerings in those use cases. So, the focus of privately oriented data space initiatives is not on being fully inclusive in terms of customers and business model, although in exceptional cases inclusivity might be part of their unique selling point.

Naturally, privately oriented initiatives are drawn to use cases and applications that have direct commercial potential, and not so much on creating public value that is more difficult to bill for. This could lead to the adoption of market practices that are generally considered harmful or going against public value or values.

Privately oriented initiatives tend to focus on value capture. Often terms of use for participation in the initiative are set in such a way that value capture (revenue) by the investor(s) is served. If investors change the requirements on the returns on their investments (ROI), the terms of use are often changed unilaterally by the initiative (e.g., pricing or other conditions for participation in the

initiative). This is, however, in conflict with the generally accepted principles of data spaces, because the participants are in such a case left with only the option either to accept the change or to withdraw from participating in the initiative totally, which latter comes with the drawbacks of no or only few alternatives to switch to and/or high switching costs. This behaviour is especially observed among Big Tech platform providers in the last decades, and it happens when the development of data sharing initiatives is completely left to the market without interventions of public authorities.

In summary, some of the drawbacks of privately oriented approaches to data space development are:

a) less inclusive concerning their customers and business model, which could lead to a situation in which they focus on the customers who pay the most.

b) less focus on the public value that is more difficult to bill for, which could lead to market practices that are generally considered harmful or going against public value or values.

c) if investors change the requirements on the returns on their investments (ROI), the terms of use could be changed unilaterally by the initiative.

To address some of these drawbacks, several mitigating actions can be taken. A potential solution could be to work with mixed financing whereby part of the data space is financed by private money and part of it is funded by public money. This mixed financing enables to stimulate inclusiveness and respect of public values based on certain agreements, while stimulating the business viability. These agreements could state for instance that the public funding will only be provided if the data space initiative adhere to agreements on inclusiveness, some public values and that terms of use are not allowed to change in an unilateral way. This approach needs to be aligned with state aid rules.

On the other hand, private financing also has its benefits. The private oriented approaches on data space development has the advantage that It focus on financial returns and business viability, which in general stimulates the financial sustainability of the data space.

2.2.2 Linear vs multi-sided approach

Another perspective is taking a **linear vs. multi-sided approach** to business thinking.

Linear approach

Linear business thinking is focused on a data space initiative delivering a valuable product or service. It *transforms* acquired and paid for inputs of the initiative into an offering, and the idea is that if the offering is valuable enough, the customer will adopt it and is willing to pay for it. Value is created and captured by the initiative if the customer adopts the offering and pays for it. This (classic) way of thinking is the fundament of production companies, but can roughly be observed in for example Europeana: the hypothesis is that a complete and rich collection of products and services makes an attractive offering that customers are willing to adopt and pay for. This approach, however, requires

frontloading the investment and effort of building the collection of products and services (or access to them) and doing this prior to any adoption or payment for the offering.

Multi-sided approach

While linear thinking focuses on a direct transaction between a (single) provider and multiple customers, multi-sided thinking shifts the focus to *enabling interactions* between multiple providers and multiple customers. This implies that the core function of the initiative is to serve transactions, by finding both users and offers of (specific) data. Having an excellent collection of offerings by multiple providers is attractive to customers, and a large customer base is attractive to providers. This is what can be observed at successful platforms, for instance, that match substantial demand with substantial supply. Therefore, this characteristic is also referred to as "multi-sided business model" (e.g., supply of offerings, services that enrich data (e.g., vizualization) and demand for offerings).[8] Note that a data space has in the way it functions between supply and demand sides strong resemblance of the way platform business models operate, but with the clear and fundamental difference that data spaces are not owned or controlled by a single organisation.

Instead, a data space is composed of a network of interoperable participants, who collectively enable transactions between themselves to take place. Participants include supply-side actors (offering providers, including service providers *within* the data space) and demand-side actors (offering customers) as well as a network of data space *enabling* service providers. Enabling service providers can specialise in offering services specifically to supply side or demand side actors, or they can be generic infrastructure providers.

Multi-sided thinking acknowledges the interdependencies and network effects on and between both supply and demand sides. It acknowledges explicitly that participation in the initiative should also be attractive to the offering providing side. An interested party, such as a public funder or a private investor, may even temporarily subsidise specific demand or supply, to create or strengthen the network effect.[9] This is sometimes difficult, if the building of the collection of offerings is, for example, publicly funded and performed by a single organisation, then the future, post-public investment, incentives for participation of the 'supplying side' may be overlooked. As initially the cost of participation is readily covered by the public funding, but usage of the supplying side is not yet established. A supplying organisation then has less incentive to convince the mediator to promote specific offerings and be a part of the value creation, risking supply to be left unnoticed and unused.

Consequently, to mitigate against risks, the development of multi-sided business models requires a more balanced and iterative approach to building both supply and demand sides, rather than first

[8] Sometimes, multi-sided business models are also referred to as "two-sided business models" or, confusingly here, "platform business models".
[9] This can be observed in the pricing that Uber: prices are higher if limited drivers are available. In this way supply is attracted.

securing supply. Iterations are needed to consider how either supply or demand can be improved to be in a continuous match (i.e., most of the supply capacity is being used, and most of the users' needs are met).

The multi-sided thinking has proven to be very challenging for both publicly funded and privately financed initiatives. Research shows that many initiatives with multi-sided business models (such as data spaces) fail for strategic reasons.[10] [11] One key reason is that a multi-sided business model requires continuously balancing the offering (of the mediator) to both supply and demand sides. This puts forward constant challenges: how to attract and increase the supply or how to attract and increase the usage of data?

Balancing sides may involve marketing campaigning (creating awareness on one side) or cross-subsidising (discounting prices on one side) etc. It is very hard to plan and monitor the establishment of network effects. This is in contrast to, for example, linear progress measurements in building a data collection. Here, counting the number of suppliers and connected datasets may suffice. Furthermore, many multi-sided business initiatives require multiple Investment rounds to achieve a level of income to cover operational costs.[12] [13] This has important implications for publicly funded projects with linear progression indicators, as lengthy funding is required.

Valley of Death

The time between founding the data space and the moment networking effects start is part of the Valley of Death. The Valley of Death is the stage in the research and development process where an innovation (in this case the data space under development) has reached the proof of concept stage (meaning the innovation works), but the business still does not break even.[14] The Valley of Death, can go for data spaces beyond the common market perspective (such as supply-and-demand, lack of risk-willing capital, future market uncertainty, law of diffusion on innovations etc.) and can be based on different types of market failure such as:[15]

[10] Özcan, L., Koldewey, C., Duparc, E., van der Valk, H., Otto, B., & Dumitrescu, R. (2022). Why do digital platforms succeed or fail?-A literature review on success and failure factors.
[11] Van Alstyne, M. W., Parker, G. G., & Choudary, S. P. (2016). Reasons platforms fail. Harvard business review, 31(6), 2-6.
[12] Teixeira, T. S., & Brown, M. (2016). Airbnb, Etsy, Uber: Acquiring the first thousand customers. President and Fellows of Harvard College.
[13] Teixeira, T., & Brown, M. (2016). Airbnb, Etsy, Uber: Growing from one thousand to one million customers. Business Research for Business Leaders, Harvard Business School: President and Fellows of Harvard College, 516-1108.
[14] Gbadegeshin et al, (2022), Overcoming the Valley of Death: A New Model for High Technology Startups, Sustainable Futures; https://www.sciencedirect.com/science/article/pii/S2666188822000119
[15] Stolwijk et al. (2017), Financing Fieldlabs (2017), https://www.kansenvoorwest2.nl/files/tno-financieringvanfieldlabs.pdf

1. **Imperfect and asymmetric information:** due to imperfect and asymmetric information, private investors may be reluctant to finance valuable projects (in this case the data space and its services). As a result, the allocation of financial resources may not be adequate.

2. **Coordination failure:** The ability of undertakings to coordinate with each other or to interact to deliver the development of an innovation (in this case a data space) may be impaired for various reasons, including difficulties in coordinating among a large number of collaborating partners where some of them have diverging interests, problems in designing contracts, and difficulties in coordinating collaboration due to, for example, sensitive information being shared.

3. **New European legislation:** provides a scope for data spaces in which various stakeholders are not yet familiar to navigate, which could make them reluctant to join a data space.

4. **Potential customers have the tendency to focus on conventional technologies:** to share and store their data on solutions offered by big tech platforms as these are known, easily available on the market, and relatively cheap.

Due to these types of market failures, among other things, it is sometimes unclear to investors and potential customers why a data space should be started in the first place. Innovation funding (often public) is therefore a common starting point to overcome this market failure. The focus often rests on available data and the overarching goal of enabling a data space, rather than addressing specific business problems. This set of circumstances makes the value proposition of a data space at times difficult to both find and communicate. Additionally, these circumstances can delay experimentation with different value propositions, extending the Valley of Death and thus decreasing the chances of survival for the data space. BOX 2 elaborates on the experimentation with value propositions of a data space.

BOX 2:

Experimenting with value propositions for specific customers from the start of the data space is an important way in which the Valley of Death can be crossed. For example, in several data space initiatives, a nominal fee from end users was considered, but met objection from those who are already facing effort and costs to meet data space requirements. There is a decision point here for initiatives on exactly when they would want to impose a fee, and for whom. One experiment could be the introduction of a fee on particular types of data and related services and then testing how many users will leave the data space. Other revenue models could be considered as well. These would not need to be revenue models that aim at profitability, but they should work as a proof-of-concept to enable potential data space participants to see monetary value in their participation which can stimulate their willingness to pay for it.

Just like in any other business, within data spaces there are value propositions that are segment-specific: for each type of 'customer', therefore one should create different user stories, services, and products to support each of these customer groups. Especially, since data spaces might have multiple distinctive groups of customers that are interdependent on one another.

3. Development pathways to deal with the business challenge

This chapter gives insights in the development pathways to deal with the business challenge as discussed in Chapter 2. To navigate the 'business challenge' of a data space we propose the following framework including five dimensions: 1. data and Infrastructure, 2. users and authorisation, 3. use cases and their applications, 4. vision and governance, 5. business and viability. These five dimensions (although the list is not exhaustive) are used since they often play a role in the business challenge of a data space (see Figure 3). They are derived from analysing the evolution of various data space initiatives. The idea here is not to consider each of these dimensions in a particular order, but in coherence. This means one can start at any point. The DSSC Blueprint provides more detail to the dimensions of this framework such as the data, use cases etc.[16] The approach below suggests how to navigate these dimensions of the business challenge.

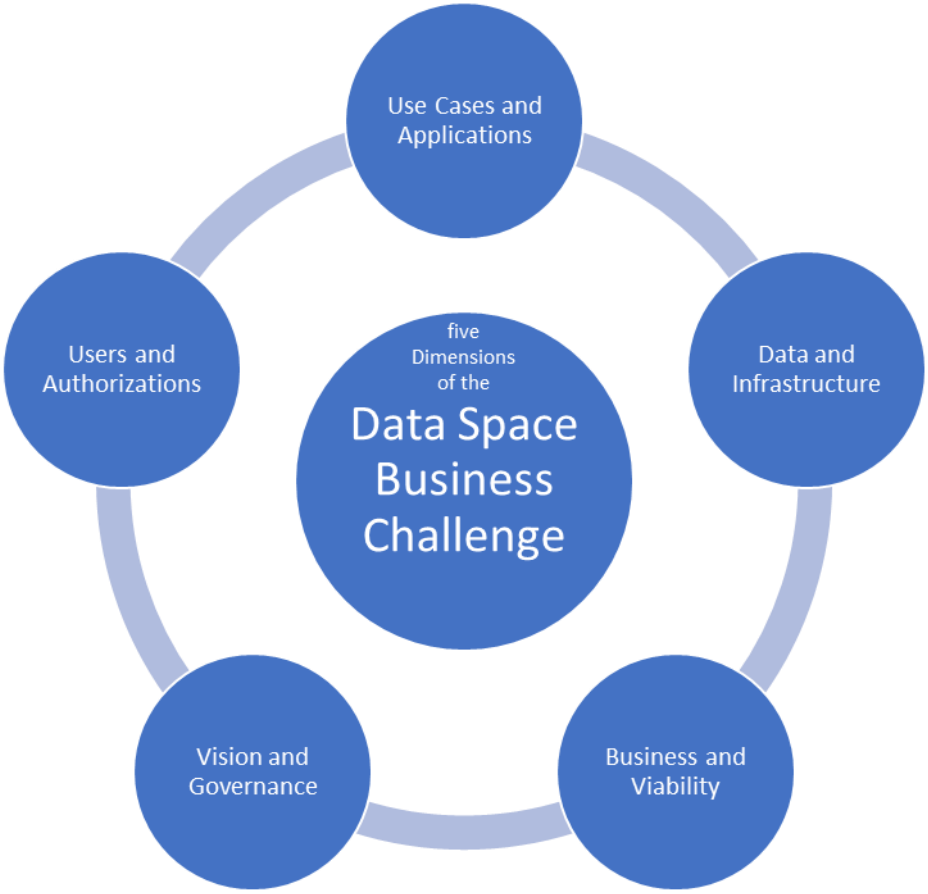

Figure 3 Framework with dimensions of the business challenge

[16] DSSC Blueprint: https://dssc.eu/space/BVE2/1071252828/Business+Model

1. **Data and infrastructure:** is about the scope, quality, and availability of data that can be accessed through participation in the data space. It also involves the actions the initiative employs to curate and grow its data collection. This is the 'supply' side of the business challenge.

2. **Users and Authorisations:** is about which and how many users are affiliated with the initiative and how users are empowered to authorise and control usage of data. This reflects the sovereignty principle of data space initiative.

3. **Use Cases and their Application:** represent the demand side of the business challenge and includes the use cases and applications the data space supports and also the activities it employs to curate and grow demand for itself and the offerings within it.

4. **Vision and Governance:** is about the what the initiative aims to achieve, and how it is organised.

5. **Business and Viability:** is about how the data space initiative aims to get the revenues to cover for its costs.

3.1 Development pathways of data space initiatives

In this section we introduce five illustrative examples of data spaces and data space related initiatives. We briefly discuss their evolution along the five dimensions of the business challenge introduced above. In the sections below each of the examples are discussed, followed by a table per example that shows the evolution. The evolution stages are numbered from 1 to 4 to indicate what came first and what followed. Following the previous chapter, we reflect on each example from the public, private and multi-sided perspective.

3.1.1 DjustConnect

DjustConnect is a data space designed and operating for the agri-food sector in Flanders. Launched by ILVO, a research and technology organisation for agriculture, and several agricultural firms, it aims to facilitate the secure and efficient exchange of data among farmers, businesses, and other stakeholders in the agricultural supply chain.[17] DjustConnect came into existence out of a European Fund for Regional Development research project. There are three governance layers. First, ILVO owns the data space and acts as the data space operator. They have however made an explicit effort to create as much buy-in from their stakeholders as possible. Second, there is a steering committee consisting of agricultural firms that together with ILVO determine the strategic direction of DjustConnect. Third, there is a more general stakeholder group with parties that are in the ecosystem but are not in the steering committee. Supported by these bodies, ILVO acts as the

[17] Launch of DjustConnect - data sharing platform for the agri-food chain | DjustConnect

governance authority. DjustConnect allows farmers and other agricultural companies to streamline administrative processes and enhance management support, and they also provide technical advice related to the different applications which are available in the ConnectShop.[18] [19] The data space's primary purpose is to empower farmers by giving them control over their data (sovereignty), ensuring they decide and control who accesses their data.

DjustConnect started with similar principles, and partly overlapping organisations, as the JoinData initiative (discussed below), but with a different geographical scope. DjustConnect evolved in a different way: In DjustConnect the development of use cases and applications is shifted out to the ConnectShop, with a selection of APIs for many data sources. In other words, so far emphasis has been on the data/infrastructure aspect of the business model, and on the farmers offering access to their data. Gradually use cases and applications seem to increase.

See Table 1 below for an overview of the dimensions of the business challenge for DjustConnect. Following the description above all five dimensions of the business challenge are addressed roughly in two stages, as presented in the following table.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
DjustConnect	1	Regional development funding			Steering committee	Buy-in from sector
	2		Empower farmers	Externalised via ConnectShop		

Table 1 Framework with dimensions of the business challenge of DjustConnect

So far, the emphasis of this initiative is on the public side. The development of the initiative is largely funded by public money, and its key coordinator ILVO is a publicly funded institute. However, there are private and cooperative organisations in its close group of stakeholders. Further private activity is clearly scoped out via the ConnectShop. This also seems to imply that the multi-sided perspective, balancing demand and supply of data is relying on the materialisation through the initial 'buy-in from the sector'.

3.1.2 Smart Connected Supply Network

Smart Connected Supplier Network (SCSN) is a data space aimed at enhancing information exchange efficiency within the manufacturing supply chain, mainly located in the Eindhoven region of the Netherlands. Initially, several digital platforms provided proprietary interconnectivity between enterprise resource planning (ERP) systems for OEMs (Original Equipment Manufacturers, typically branded organisations that design and assemble equipment for end-users from 1st and 2nd tier suppliers). Transitioning to a data space required establishing interoperability among these platforms. This started off with a research project to demonstrate feasibility, followed by forming a

[18] ConnectShop | DjustConnect
[19] DjustConnect

governing body. The starting point was existing use cases like invoicing and product planning, with scaling potential. Many manufacturing organisations are already part of an overarching governing body of the SCSN data space, with data providing and using actors, and service providers. These services providers now offer standardised functionalities, benefiting users with access to a wider set of supply-chain participants than a single platform could have. The target audience includes manufacturing companies and their IT suppliers, particularly those working with low volume, high mix, high complexity products. Current challenges include increasing the value of the data space by boosting interactions and additional use cases.[20]

The SCSN data space has focused initially primarily on establishing interoperability on the data/infrastructure side. This however required collaboration among service providers to collaborate. This yields a vision on a shift from supply chains to supply networks to increase efficiency and resilience in the manufacturing sector. Business and Viability are established by increased network effects among manufacturing companies, and service providers standardising only a basic part of their service offering, while holding on to a specific focus on segments and corresponding functionality. The use case was existent (i.e., ordering and invoicing) and the service providers already had their customers. However, the long-term development still has to prove itself, now that the data space is scaling further.

See Table 2 below for an overview of the dimensions of the business challenge for SCSN. The table reflects the storyline above and shows that the five dimensions are developed in roughly four stages and that most dimensions are developed in stage 2.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
SCSN	1	Develop semantic standard in prototype				
	2		Existing platform users	Existing use case	Set governing body	Service providers' network effects
	3					Additional service providers
	4			Additional use cases		

Table 2 Framework with dimensions of the business challenge of SCSN

[20] Smart Connected Supplier Network - EUHubs4Data

3.1.3 JoinData

JoinData is a data sharing cooperative in the agriculture domain, whose development we have analysed in four stages (see Table 3).

- **Stage 1.** JoinData initially started as a small technology driven proof-of-concept focused on showing how various on-farm data sources can be fused to support precision farming.
- **Stage 2.** After this successful project, a consortium of research organisations and dairy farming cooperatives set out to develop a vision based on efficiently sharing on-farm sensor data for the purpose of smart and sustainable dairy farming practices, whilst allowing farmers to stay in control of their data.
- **Stage 3.** Following the commitment from a few large dairy cooperatives a dual strategy focused was set out: on the one hand connecting existing data sources as supply and on the other hand setting up R&D projects to develop applications that represent demand for data. At this point, we consider JoinData a data space avant-la-lettre.[21] The revenue model is based on a fixed fee per farmer, initially paid for by the cooperatives. The core of the value proposition for the farmer is based on managing authorisation for sharing data. The governance of the data sharing initiative was first embedded in a foundation.
- **Stage 4.** Later, the foundation turned into a cooperative of cooperatives and other organisations and expanded scope beyond dairy farming into general agriculture. Many of the use cases are related to sharing data for taxation, accountancy, and reporting, and authorisation management is still at the core. This chronology shows a start focused on piloting a data register, then novel use cases, then focus onboarding existing administrative data sets, and a later shift to focus on authorisation for existing services and legal compliancy.[22]

JoinData has also had a journey along the five dimensions. It started off with a technical and interoperability focus on Data/Infrastructure, anticipating a multi-sensor precision farming future. Next, focus was on building governance among large cooperatives based on a joint vision on empowering farmers and establishing sovereignty. Then the focus was on developing value adding use cases. Focus on users and business growth was initially less prominent, as this was ensured by participation of large cooperatives. However, upon the transition from the dairy sector exclusively to a wider approach to the farming sector, the initiative gradually merged with complementary initiatives. This thus expanded the use cases, users, data, governance participation and business simultaneously.

[21] The initial architecture of the system had many elements similar to a data space, e.g., it was based on a registry and locally controlled data, using a standardised interface. Currently several shared data sources are however managed by a service department of one of the cooperatives members. Despite a deviation from the architecture, the business model of this data sharing initiative is collaborative and multi-sided.
[22] Homepage - JoinData

See Table 3 for an overview of the dimensions of the business challenge for JoinData. All five dimensions are developed in four stages. Most dimensions are developed in the stages 3 and 4.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
JoinData	1	Proof of Concept				
	2		Based on user control		Develop vision	
	3	Data-space-like	Cooperative members	Several use cases	Foundation	
	4	Architectural change	Authorisation module	Other administrative use cases from other initiatives	Cooperative	Merging with other initiatives

Table 3 Framework with dimensions of the business challenge of JoinData

This Initiative started off in the first stage with a publicly funded consortium, with also private in-kind contributions. Its focus was primarily on value for private organisations (farmers), and through farming practices on society. In the second phase the governing body included private cooperative organisations and the projects were mixed public/privately financed. Some of the existing applications that were onboarded had a focus on administrative compliancy, i.e., was focused on data sharing with a governmental body. The multi-sided aspect of the Initiative is addressed through the onboarding of Initiatives that bring additional applications and partially overlapping and new users.

3.1.4 FEDeRATED

FEDeRATED is an EU initiative designed to create a data space for seamless data sharing in the freight transport and logistics sector. It aims to address the challenges of data fragmentation and to enhance interoperability and harmonisation of logistics data across Europe. The target audience includes logistics operators, public institutions, and other stakeholders involved in the supply chain. The project's application involves developing a secure, open, and neutral data-sharing infrastructure that facilitates the exchange of information on visibility, identity, business documents, ordering, and planning. Use cases of the data space include supply chain visibility and optimised asset capacity and infrastructure use with the ultimate purpose to enhance the efficiency and resilience of the transport ecosystem.[23]

FEDeRATED began as a European project, which ran from 2019 to 2024. The next steps are for early adopters to form a data space. The initiative has focused on one hand on the vision of seamless logistics, and on the other hand the development of the infrastructure and demonstration of use cases across Europe. The outputs of this project are now considered for further elaboration in several follow-up projects.

[23] **FEDeRATED | Home**

See Table 4 for an overview of the dimensions of the business challenge for FEDeRATED. Four of the five dimensions are developed in stage 1. Dimension two on users and authorisation is not developed so far.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
FEDeRATED	1	secure, open, and neutral data-sharing infrastructure		supply chain visibility, optimise asset capacity and infrastructure use	Seamless logistics	Representation from industry
	2		Awaiting early adopters			

Table 4 Framework with dimensions of the business challenge of FEdeRATED

FEDeRATED Is a publicly funded mixed public/private consortium, and focused on private sector applications and public/private applications. Its outputs are currently in the public domain. Although in the project potential supplying and demanding actors were represented, the multi-sided aspect Is essentially not addressed.

3.1.5 Europeana

Europeana is an initiative focused on organising access to a distributed collection of digitised cultural heritage items from, e.g., libraries and museums, through the sharing of metadata. In 2008, the initiative started with 2 million objects listed, and now over 50 million objects are included and accessible through thousands of organisations. Europeana is a source for educational programmes. The initiative also supports its member organisations in digital transformation by means of advice and tools. The focus of this initiative is on making available digital cultural materials and supporting the digital transformation of the cultural sector. The use of the portal is supported by examples, instructions, and tips. The initiative has focused primarily on the building of an extensive catalogue (Data/infrastructure) and the necessary agreements to make collections accessible.

See Table 5 for an overview of the dimensions of the business challenge for Europeana. Three of the five dimensions are developed in two stages. The dimensions users and authorisation and Business and Viability are not developed so far.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
Europeana	1	Digitisation of heritage catalog				
	2	Catalog of metadata			Europeana network	
	3			Advice and tools		

Table 5 Framework with dimensions of the business challenge of Europeana

Europeana is a publicly funded Initiative, primarily focused on content from mostly (fully or partially) publicly funded cultural organisations, and aimed at applications and use cases Involving typically

also publicly funded organisations (e.g. education Institutes). Through its focus on catalogue representation and access, the initiative hardly addresses the multi-sided aspect.

3.2 Concluding summary of the data space initiatives

The evolutions illustrated above reveal that data spaces and data space related initiatives evolve and iterate. Some initiatives seem to have not (yet) addressed a few dimensions, whereas other revised their view on certain dimensions over time. In the cases of SCSN and JoinData, there is a noticeable combination of an 'aggregate actor' (industry association or cooperative), a set of users (manufacturing companies or farmers), and existing applications (ERP systems or administration of nutritional compounds). In the JoinData case, growth was also established by onboarding into the data space fully operational initiatives that were not yet collaborating with data space.

Table 6 below provides an overview of the evolution and the iterations we have observed across all five examples studied.

	Stage	Data and Infrastructure	Users and Authorisation	Use Cases and Applications	Vision and Governance	Business and Viability
DjustConnect	1	Regional development funding			Steering committee	Buy-in from sector
	2		Empower farmers	Externalised by ConnectShop		
SCSN	1	Develop semantic standard in prototype				
	2		Existing platform users	Existing use case	Set governing body	Service providers' network effects
	3					Additional service providers
	4			Additional use cases		
JoinData	1	Proof of Concept				
	2		Based on user control		Develop vision	
	3	Data-space-like	Cooperative members	Several use cases	Foundation	
	4	Architectural change	Authorisation module	Other administrative use cases from other initiatives	Cooperative	Merging with other initiatives
FEDeRATED	1	secure, open, and neutral data-sharing infrastructure		supply chain visibility, optimise asset capacity and infrastructure use	Seamless logistics	Representation from industry
	2				Awaiting early adopters	
Europeana	1	Digitisation of heritage catalog				
	2	Catalog of metadata			Europeana network	
	3			Advice and tools		

Table 6 Framework with dimensions of the business challenge of all examples

4. Conclusions and recommendations

4.1 Conclusions

In this paper, we have discussed various perspectives and dimensions to the data space business challenge and studied five illustrative examples of data spaces and data space related initiatives. As a result, we offer the following conclusions:

A. Data spaces can have different starting points to cover their business challenge.
Data spaces can start from different dimensions, e.g., 1. data, 2. users and authorisation, 3. use cases and their application, 4. vision and governance, 5. business and viability, to become self-sustaining. Often based on a step by step approach. The number of stages needed to address these dimensions differs significantly per initiative.

Data spaces can also start from either a public and or a private perspective, but each perspective requires a different approach with different points of attention. This paper indicates that:

- Public data spaces need to start working towards value propositions for specific customer segments from an early stage. It is also important to keep in mind that research funding is not the same as purchasing decisions, even within the government. Even though subsidies also come from the government, a purchasing decision is a different stream of finance and hence has a different process and approval.

- Private data spaces need to remember their right to play and have to pay attention to the inclusivity of their customer base and business model (by ensuring proper value propositions for the involved stakeholders).

B. The data space needs a clear scope and guidelines about where data can and cannot be used to enable business decisions.
Given that sovereignty over data lies with the rights holders, having a clear scope of the data space is key to give the data space some leeway to take business decisions, allowing it to adjust pricing and other elements of the offering via some mechanism. The data space needs clear guidelines about where data can and cannot be used. If it remains exclusively a decision for the participants, it will not grow. This does not necessarily need to be a problem if all participants are able to ensure that service providers receive the funding that they need, but this remains a precarious situation where any shocks (such as a participant pulling out) create larger than necessary risks for the data space.

C. Both public and private data spaces require value propositions for different user types.
As data spaces are inherently multi-sided, different value propositions need to be developed for both the supply side actors and the demand side actors. It is important to ensure that the end-user networks of supply and demand create enough value so that the enabling services and governance authority can be sustained.

D. Multi-sided business models are difficult to establish and require network effects to be sustainable.

Hence, data spaces require experimentation early on in their development, to find out which value propositions create networking effects most efficiently. This is an iterative process which requires a continuous learning curve. While linear thinking focuses on a direct transaction between provider and customer, multi-sided thinking shifts the focus to enabling interactions between multiple parties.

E. Data space initiatives have challenges to deal with the Valley of Death.

The data spaces should try and cross the Valley of Death as soon as possible to ensure financial sustainability and thus survival. This is important because time frames to profitability or financial sustainability are relatively long for data space initiatives.

4.2 Recommendations

Based on these conclusions we come to the following recommendations:

1. Although there is a lot of freedom about which starting point to take, it is important to balance the public and private perspectives, practice multi-sided thinking, and consider all the dimensions of the business challenges to start with to ensure a smooth and efficient data space development process (Related to conclusions A, C and D).

2. It is important to develop a clear list of specific data space offerings, including the market segments to which these offerings will be aimed, pricing, terms and conditions, etc. to proactively cover the business challenges around dimension “data and infrastructure”. Be specific and, ideally, have a sales team in place that can guide the discussion around how best to sell these offerings, and actually sell the offerings (Related to conclusion A).

3. In publicly oriented data spaces, treat national or regional governments as clients, spend time exploring public procurement questions and understand what is needed to convince purchasing managers to purchase an offering (Related to conclusion A and C).

4. To mitigate the Valley of Death, a data space needs cooperation between public and or private partners that enable cost sharing and experimentation with value propositions of the data space (Related to conclusion E).

5. Keep in mind that time frames to profitability or financial sustainability of data spaces are relative long. This either needs to be built into the business plan or, in case of public funding, in the funding mechanisms for the data space (Related to conclusion E).

6. Negotiate the scope of the data space and where data can and where data cannot be used to ensure a leeway to take business decisions (Related to conclusion B).

7. Although cross-data space interoperability is not the main focus of this paper, data spaces should start to build their business model within their own boundaries first, and once established, look beyond to other data spaces to see what synergies and options for cross-data space interoperability can be found. This step-by-step approach is recommended to avoid extra complexity (Related to conclusion A).

All in all, data spaces are still under development and therefore deal with some business and market challenges for which the aforementioned recommendations are provided. The idea for data spaces is to channel their inner baron Von Münchhausen and pull themselves out of the mud. They can do so by challenging themselves to consciously navigate the strategic dimensions of the presented framework, and actively balance both public and private perspectives, as well as practicing multi-sided thinking.